

# Optical Properties of Black Carbon and Brown Carbon and Their Contribution to Aerosol Light Absorption

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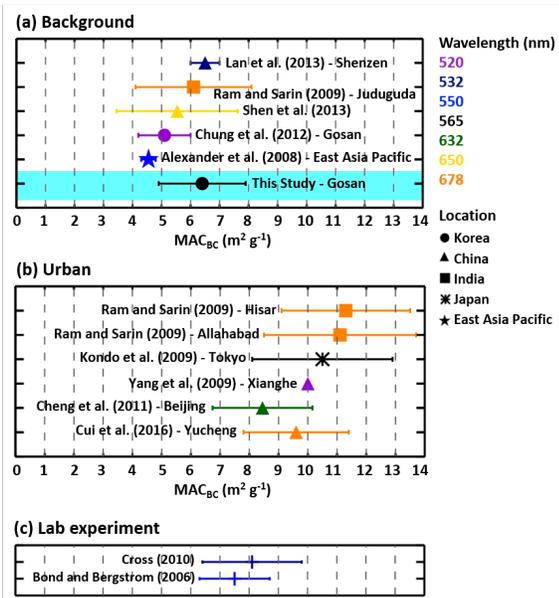
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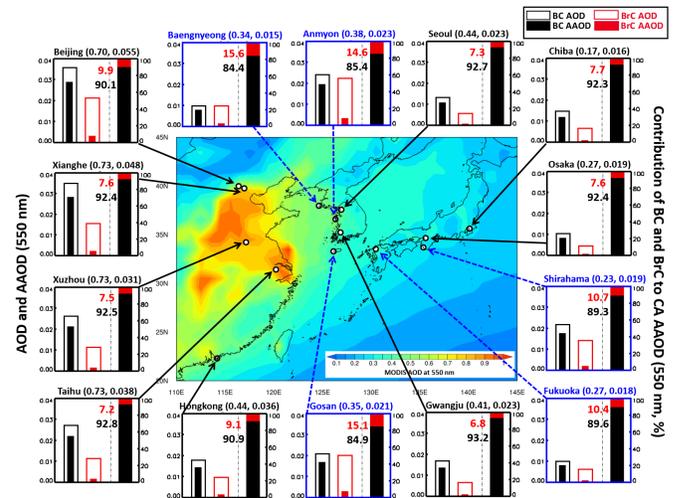
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We estimated the contribution of black carbon (BC) and brown carbon (BrC) to aerosol light absorption from surface *in situ* and column aerosol robotic network (AERONET) observations. The mass absorption cross section (MAC) of BC ( $MAC_{BC}$ ) was estimated to be  $6.4 \pm 1.5 \text{ m}^2 \text{ g}^{-1}$  at 565 nm from *in situ* aerosol measurements at Gosan, Korea, in January 2014, which was lower than those observed in polluted urban areas (Figure 1). A BrC MAC of  $0.88 \pm 0.05 \text{ m}^2 \text{ g}^{-1}$  (565 nm) in our estimate is approximately seven times lower than  $MAC_{BC}$  at 565 nm. The contribution of BC and BrC to the carbonaceous aerosol absorption coefficient at 565 nm was estimated at  $88.1 \pm 7.4\%$  and  $11.9 \pm 7.4\%$ , respectively. Similarly, the contribution of BC and BrC to the absorption aerosol optical depth (AAOD) for carbonaceous aerosol (CA AOD), constrained by AERONET observations at 14 sites over East Asia by using different spectral dependences of the absorption (i.e., absorption Ångström exponent) of BC and BrC, was  $84.9 \pm 2.8\%$  and  $15.1 \pm 2.8\%$  at 565 nm, respectively. The contribution of BC to CA AAOD was greater in urban sites than in the background areas, whereas the contribution of BrC to CA AAOD was higher in background sites (Figure 2). The overall contribution of BC to CA AAOD decreased by 73%–87% at 365 nm, and increased to 93%–97% at 860 nm. The contribution of BrC to CA AAOD decreased significantly with increasing wavelength from approximately 17% at 365 nm to 4% at 860 nm.



**Figure 1.** Comparison of  $MAC_{BC}$  measured at the (a) background and at (b) urban sites, and from (c) laboratory experiment. The symbols and colors represent observed locations and wavelengths, respectively (see right of figure).



**Figure 2.** AOD (open bar) and AAOD (filled bar) of BC (black bar; left Y-axis) and BrC (red bar; left Y-axis), and their contribution to AAOD (percentage; right Y-axis) at 14 AERONET sites (9 urban: black arrow, 5 rural: blue dashed arrow). Mean AOD and AAOD (in parentheses) at each site are given with site name at the top of the figure. The contribution of BC (black) and BrC (red) to CA AAOD in percentage (%) are given inside each figure. The background color map denotes 14-year average MODIS AOD (Level 3 Collection 6) at 550 nm over East Asia.